

**What is claimed is:**

*Drawn* 1. A network, including a source of multicast packets in a multicast session and a plurality of multicast recipients in that session, comprising:

a repair server in the network monitoring received ones of the packets to said recipients, the repair server including a missing packet detector; and

a plurality of retransmit servers in the network buffering portions of the packets during the session;

said repair server detecting missing packets and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers.

2. The network of claim 1, which further comprises:


said repair server including an ordered list of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

said repair server detecting that there are packets missing from the session it has received, and using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

3. The network of claim 2, which further comprises:

said ordered list ranking the respective retransmit servers based on the performance of the retransmit servers in past repair sessions.

*Drawn* 4. The network of claim 2, which further comprises:

*Draw AI*  said ordered list ranking the respective retransmit servers based on receiver reports multicast by each of the retransmit servers.

5. The network of claim 2, which further comprises:

said ordered list ranking the respective retransmit servers based on the fraction of data packets from the source lost by a retransmit server.

6. The network of claim 2, which further comprises:

said ordered list ranking the respective retransmit servers based on the cumulative number of packets from the source that have been lost by a retransmit server.

7. The network of claim 2, which further comprises:

said ordered list ranking the respective retransmit servers based on an estimate of the statistical variance of the packet interarrival time experienced by a retransmit server.

8. The network of claim 2, which further comprises:

said ordered list ranking the respective retransmit servers based on the round trip propagation delay between the source and a retransmit server which may be used as an approximate measure of distance between the source and the retransmit server.

9. In a network including a long-haul portion with multicast enabled routers and non-multicast enabled routers, the network further including a source of multicast packets in a multicast session coupled to a first node of the long-haul portion, and the network further including a plurality of multicast recipients in that session coupled to a second node of the long-haul portion, a multicast session repair system, comprising:

Sub A1  
a repair server in the network monitoring received ones of the packets in the multicast session to said recipients, the repair server including a missing packet detector;

a plurality of retransmit servers in the network buffering portions of the packets during the multicast session;

said repair server detecting missing packets and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers; and

a unicast message processor in at least one of the retransmit servers, retransmitting in a unicast session to the repair server at least a portion the missing packets in response to one of said requests;

said retransmitted packets in said unicast session being forwarded by at least some of the non-multicast enabled routers in the long-haul portion, to thereby circumvent at least some of the multicast enabled routers in the long-haul portion.

10. The network of claim 9, which further comprises:

said repair server including an ordered list of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

said repair server detecting that there are packets missing from the session it has received, and using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

11. The network of claim 10, which further comprises:

said ordered list ranking the respective retransmit servers based on the performance of the retransmit servers in past repair sessions.

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12. The network of claim 10, which further comprises:

said ordered list ranking the respective retransmit servers based on receiver reports multicast by each of the retransmit servers.

13. The network of claim 10, which further comprises:

said ordered list ranking the respective retransmit servers based on the fraction of data packets from the source lost by a retransmit server.

14. The network of claim 10, which further comprises:

said ordered list ranking the respective retransmit servers based on the cumulative number of packets from the source that have been lost by a retransmit server.


15. The network of claim 10, which further comprises:

said ordered list ranking the respective retransmit servers based on an estimate of the statistical variance of the packet interarrival time experienced by a retransmit server.

16. The network of claim 10, which further comprises:

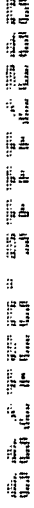
said ordered list ranking the respective retransmit servers based on the round trip propagation delay between the source and a retransmit server which may be used as an approximate measure of distance between the source and the retransmit server.

17. A method for repairing multicast packets in a network including a source of multicast packets in a multicast session and a plurality of multicast recipients in that session, comprising:

*Sub A1*  monitoring received ones of the packets to said recipients with a repair server in the network;

buffering portions of the packets during the session at a plurality of retransmit servers in the network;

detecting missing packets in said repair server and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers.

*Sub A1*  18. The method of claim 17, which further comprises:


forming an ordered list at said repair server, said list storing identities of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

detecting that there are packets missing from the session it has received at the repair server, and

using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

19. The method of claim 18, which further comprises:

said ordered list ranking the respective retransmit servers based on the performance of the retransmit servers in past repair sessions.

*Sub A1*  20. The method of claim 18, which further comprises:

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said ordered list ranking the respective retransmit servers based on receiver reports multicast by each of the retransmit servers.

21. A method to repair multicast sessions in a network including a long-haul portion with multicast enabled routers and non-multicast enabled routers, the network further including a source of multicast packets in a multicast session coupled to a first node of the long-haul portion, and the network further including a plurality of multicast recipients in that session coupled to a second node of the long-haul portion, comprising:

monitoring received ones of the packets in the multicast session to said recipients at a repair server in the network;

buffering portions of the packets during the multicast session at a plurality of retransmit servers in the network;

detecting missing packets at said repair server and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers;

retransmitting in a unicast session to the repair server at least a portion the missing packets in at least one of the retransmit servers, in response to one of said requests;

forwarding by at least some of the non-multicast enabled routers in the long-haul portion, said retransmitted packets in said unicast session to thereby circumvent at least some of the multicast enabled routers in the long-haul portion.

22. The method of claim 21, which further comprises:

forming an ordered list at said repair server, said list storing identities of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

detecting that there are packets missing from the session it has received at the repair server, and

using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

23. A method for repairing multicast packets in a network including a source of multicast packets in an original multicast session and a plurality of multicast recipients in that session, comprising:

monitoring received ones of the packets to said recipients with a repair server in the network;

buffering portions of the packets during the original session at a plurality of retransmit servers in the network;

detecting missing packets at said repair server and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers;

providing a repaired multicast session to said recipients which includes said missing packets, without requiring a change to the multicast source.

24. The method of claim 23, which further comprises:

providing a repaired multicast session to said recipients which includes said missing packets, without requiring a change to the multicast source or the recipients.

25. The method of claim 23, which further comprises:

providing both the original multicast session and the repaired multicast session to the recipients using different multicast addresses.

26. The method of claim 25, which further comprises:

allowing the recipient to selectively subscribe to the repaired multicast session as a network supplied service.

27. The method of claim 25, which further comprises:

limiting the recipient to receive the repaired multicast session as a network supplied service only if the recipient has subscribed to the multicast repair service.

28. The method of claim 25, which further comprises:

encrypting the repaired multicast session as a network supplied service and allowing the recipient access thereto only if the recipient has subscribed to the multicast repair service.

29. In a network including a long-haul portion with multicast enabled routers and a bypass portion, the network further including a source of multicast packets in a multicast session coupled to a first node of the long-haul portion, and the network further including a plurality of multicast recipients in that session coupled to a second node of the long-haul portion, a multicast session repair system, comprising:



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a repair server in the network monitoring received ones of the packets in the multicast session to said recipients, the repair server including a missing packet detector;

a plurality of retransmit servers in the network buffering portions of the packets during the multicast session;

said repair server detecting missing packets and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers; and

a bypass message processor in at least one of the retransmit servers, retransmitting in a bypass session over said bypass portion to the repair server at least a portion the missing packets in response to one of said requests;

said retransmitted packets in said bypass session being forwarded over said bypass portion, to thereby circumvent at least some of the multicast enabled routers in the long-haul portion.

30. The network of claim 29, which further comprises:

said repair server including an ordered list of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

said repair server detecting that there are packets missing from the session it has received, and using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

31. The network of claim 30, which further comprises:

said ordered list ranking the respective retransmit servers based on the performance of the retransmit servers in past repair sessions.

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32. The network of claim 30, which further comprises:

said ordered list ranking the respective retransmit servers based on receiver reports multicast by each of the retransmit servers.

33. The network of claim 30, which further comprises:

said ordered list ranking the respective retransmit servers based on the fraction of data packets from the source lost by a retransmit server.

34. The network of claim 30, which further comprises:

said ordered list ranking the respective retransmit servers based on the cumulative number of packets from the source that have been lost by a retransmit server.

35. The network of claim 30, which further comprises:

said ordered list ranking the respective retransmit servers based on an estimate of the statistical variance of the packet interarrival time experienced by a retransmit server.

36. The network of claim 30, which further comprises:

said ordered list ranking the respective retransmit servers based on the round trip propagation delay between the source and a retransmit server which may be used as an approximate measure of distance between the source and the retransmit server.

37. The network of claim 29, which further comprises:

said bypass portion being a separate dial-up network from the retransmit servers to the repair server.

38. The network of claim 29, which further comprises:

said bypass portion being a private virtual network from the retransmit servers to the repair server.

39. The network of claim 29, which further comprises:

said bypass session transmitting the missing packets in a unicast session from the retransmit servers to the repair server, thereby enabling non-multicast routers in the long-haul portion to handle the response, circumventing congested multicast-enabled routers.

40. A method to repair multicast sessions in a network including a long-haul portion with multicast enabled routers and a bypass portion, the network further including a source of multicast packets in a multicast session coupled to a first node of the long-haul portion, and the network further including a plurality of multicast recipients in that session coupled to a second node of the long-haul portion, comprising:

monitoring received ones of the packets in the multicast session to said recipients at a repair server in the network;

buffering portions of the packets during the multicast session at a plurality of retransmit servers in the network;

detecting missing packets at said repair server and in response thereto, sequentially requesting missing packets from respective ones of the plurality of retransmit servers;

retransmitting in a bypass session over said bypass portion to the repair server at least a portion the missing packets in at least one of the retransmit servers, in response to one of said requests;

forwarding by the bypass portion said retransmitted packets in said bypass session to thereby circumvent at least some of the multicast enabled routers in the long-haul portion.

41. The method of claim 40, which further comprises:

forming an ordered list at said repair server, said list storing identities of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

detecting that there are packets missing from the session it has received at the repair server, and

using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

42. A method for repairing multicast packets in a network including a source of multicast packets in a multicast session and a plurality of multicast recipients in that session, comprising:

monitoring received ones of the packets to said recipients with a repair server in the network;

buffering portions of the packets during the session at a retransmit server in the network;

Sub A2) detecting missing packets at said repair server and in response thereto, requesting missing packets from retransmit server;

said retransmit server transmitting an enhanced reliability stream of packets.

43. The method of claim 42, which further comprises:

said enhanced reliability stream of packets being supplemented by redundant packets.

44. The method of claim 42, which further comprises:

said enhanced reliability stream of packets being supplemented by block interleaving of packets.

45. The method of claim 42, which further comprises:

said enhanced reliability stream of packets being supplemented by forward error correction coding.

46. The method of claim 42, which further comprises:

forming at said repair server an ordered list of a plurality of said retransmit servers, said list storing identities of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

detecting that there are packets missing from the session it has received at the repair server, and

using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

*Sub A3* 47. A system for repairing multicast packets in a network including a source of multicast packets in a multicast session and a plurality of multicast recipients in that session, comprising:

a repair server monitoring received ones of the packets to said recipients in the network;

a retransmit server buffering portions of the packets during the session in the network;

said repair server detecting missing packets and in response thereto, requesting missing packets from retransmit server;

said retransmit server transmitting an enhanced reliability stream of packets.

48. The system of claim 47, which further comprises:

said enhanced reliability stream of packets being supplemented by redundant packets.

~~49. The system of claim 47, which further comprises:~~

~~said enhanced reliability stream of packets being supplemented by block interleaving of packets.~~

50. The system of claim 47, which further comprises:

said enhanced reliability stream of packets being supplemented by forward error correction coding.

51. The system of claim 47, which further comprises:

AB ~~said~~ forming an ordered list of a plurality of said retransmit servers, said list storing identities of the retransmit servers that are most likely to have buffered copies of packets missing from the session;

said repair server detecting that there are packets missing from the session it has received, and

said repair server using the ordered list to sequentially request the missing packets from respective ones of the plurality of retransmit servers.

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